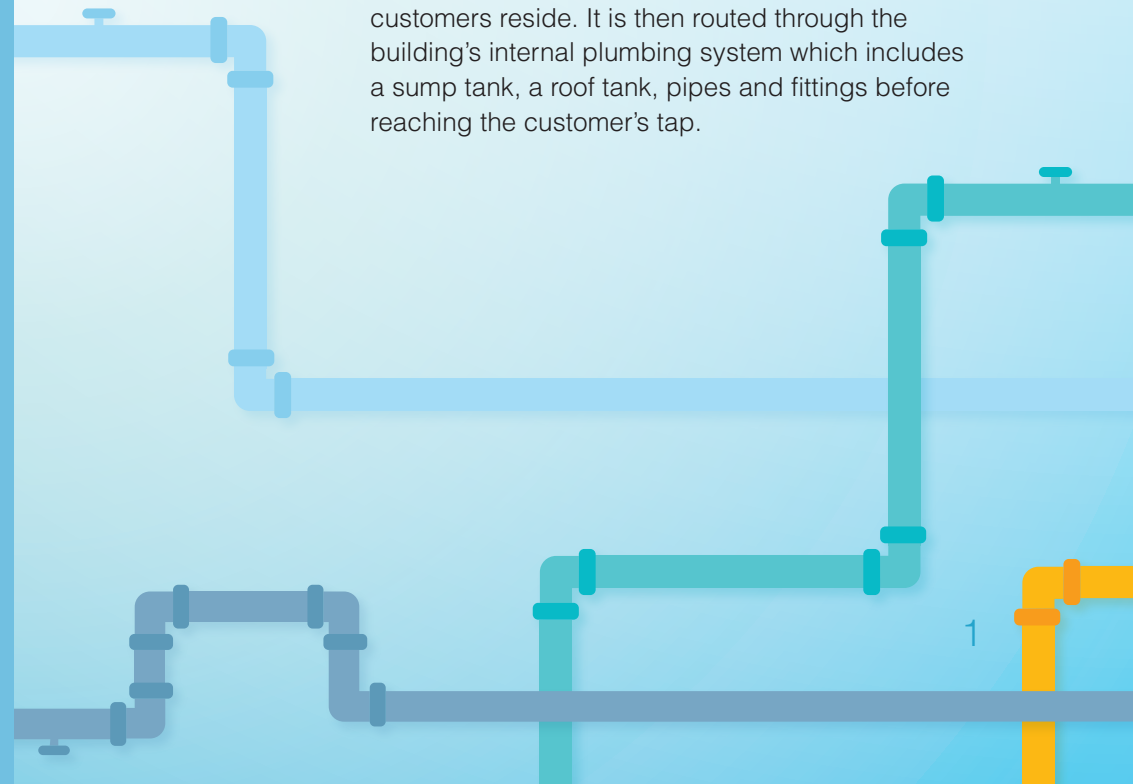


Hong Kong's Water Supply

Reducing Lead in Drinking Water

Drinking water supply in Hong Kong

The Water Supplies Department (WSD) is committed to providing quality drinking water 24 hours a day to the public. At present, raw water from Dongjiang and local impounding reservoirs first enters the water treatment works for a series of stringent and advanced treatment and disinfection processes. The treated water fully complies with the World Health Organization's (WHO) Guidelines for Drinking-water Quality. It is delivered via a huge and enclosed network of pumping stations, service reservoirs and over 6,000 km of fresh water mains to the connection point at the lot boundary (i.e. the boundary between the Government land and the lot where the customer's building is located) where customers reside. It is then routed through the building's internal plumbing system which includes a sump tank, a roof tank, pipes and fittings before reaching the customer's tap.



Maintenance of water supply system

Water pipes that join the WSD's water mains to the connection point at the lot boundary are maintained by the WSD.¹

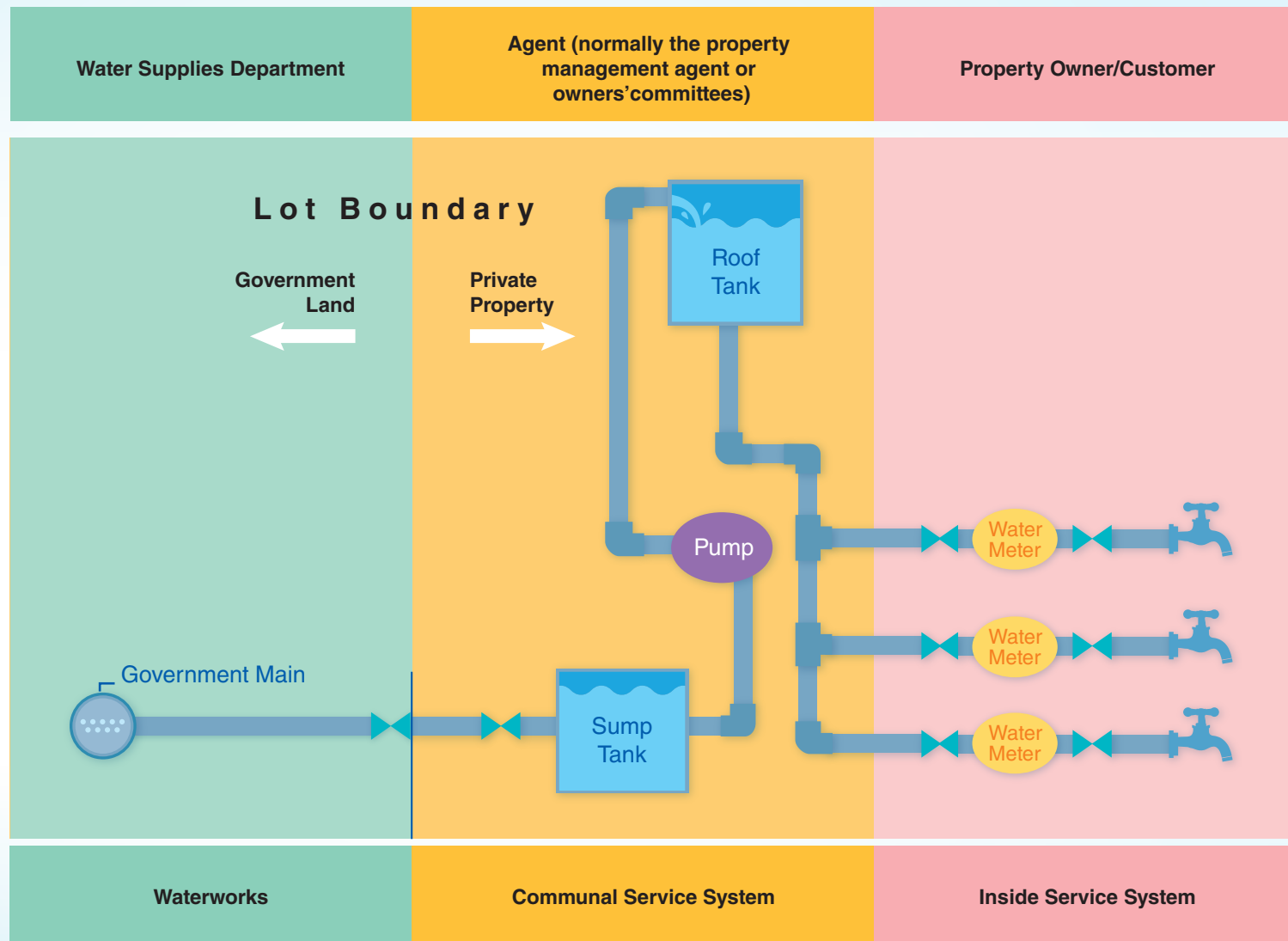
The communal service² including the service pipes from the building's lot boundary to the building as well as those communal pipes inside the building are maintained by the agent (usually the property management agent or the owners' committees).

The inside service of a flat or property is maintained by the property owner.³

Note 1: Section 4 of the Waterworks Ordinance ("Ordinance") stipulates that the duty of the Water Authority is to supply water from the waterworks and to maintain the waterworks. According to Section 2 of the Ordinance, the water pipes that join the WSD's water mains to the customers' connection points at the lot boundary are the waterworks being the properties maintained by the Water Authority (i.e. the Director of Water Supplies).

Note 2: Section 7(2) of the Ordinance stipulates that the agent of a communal service is responsible for the maintenance of the communal service.

Note 3: Section 7(1) of the Ordinance stipulates that the consumer is responsible for the maintenance of the inside service.





Water quality conforms to international standards

The quality of drinking water supplied by the WSD fully conforms to the WHO Guidelines. A Water Safety Plan in accordance with the WHO Guidelines has been in place since 2007 to further ensure a safe water supply to customers.

Hong Kong's water quality monitoring programme is comprehensive and stringent. Water quality throughout the supply system is systematically and regularly monitored at representative sampling points for analyses including physical (pH, colour, turbidity, conductivity, etc.), chemical (lead, chromium, cadmium, nickel, etc.), radiological, bacteriological (E.coli, Total Coliform) and biological examinations.

Sampling points cover the water gathering grounds, receiving points of Dongjiang water, impounding reservoirs, water treatment works, service reservoirs and distribution mains. The results of the water quality examinations are available on the WSD's website.

How does drinking water get contaminated?

Drinking water can be contaminated in a number of ways after entering the **inside service** system of a building. Contamination mainly arises from old and worn-out inside service systems, including aged or rusted pipes, improperly joined pipes, old storage tanks and faulty water supply pumps. Water can also be contaminated by substandard pipes and fittings installed during construction, renovation or replacement of the inside service system.

Where does lead come from?

Lead is a soft, grey, naturally-occurring heavy metal commonly found in air, soil, dust, food and water. In daily life, relatively high concentrations of lead might be found in paint, cosmetics and herbal medicines.

Lead pipes were once used extensively in potable water plumbing systems. In Hong Kong, lead pipes have been banned since the 1930s whilst other countries such as the United Kingdom (UK) and the United States of America (USA) have banned them since 1970s - 1980s.

Galvanized iron (GI) pipes were the most commonly used material for inside service pipes with a small diameter (100mm and below) in Hong Kong until they were banned in 1995. From 1995 to the early 2000s, lined GI pipes or copper pipes have been widely used as the small-diameter inside service pipes in new buildings. Since the early 2000s, copper pipes have gradually become the most widely used small-diameter inside service pipe in Hong Kong. They can be joined by soldering or mechanical compression joints. The use of lead-based soldering to connect copper pipes for potable water use has been prohibited in Hong Kong since the 1980s.

Copper pipes contain less than 0.1% impurities, including lead. However, copper alloy components with a minor percentage of lead

such as valves, taps and other fittings can still comply with the British Standards or other accepted standards and are commonly used in the inside service systems of buildings in Hong Kong and worldwide.

How does lead get into the drinking water?

Since some pipes or fittings, including valves and taps, may contain a small amount of lead, particularly those made of copper alloy materials, a small amount of lead can leach into drinking water due to corrosion.

Based on the experience of other countries, excessive lead in water can be caused by the inadvertent or illegal use of substandard pipes and fittings.

Factors affecting amount of lead in water

Dissolved lead in water is caused by the corrosion of inside service system components (such as fittings containing lead or lead-based solders) resulting from chemical reactions between water and the components. The corrosion rate and the amount of lead dissolved into water depends on many factors including the water temperature, pH and alkalinity, water hardness, the presence of chloride and dissolved oxygen, the type of disinfectant applied, the lead content of the components and the duration of contact with water.

In Hong Kong, hydrated lime is added to water leaving the treatment works to regulate the pH value of the water to 8.2 to 8.8. This will effectively reduce the corrosiveness of water and the leaching of lead from components.



Concerted efforts to deal with lead in water

Concerted efforts are needed to minimise the level of lead in drinking water. It entails the co-operation and participation of all stakeholders including the Government, property developers, building contractors, Authorised Persons, licensed plumbers, plumbing workers, pipes and fittings suppliers, property owners, property management agents and customers.

All materials that come into contact with drinking water (including pipes, joints, soldering materials, valves, taps and other fittings) shall comply with the relevant British Standards for potable water use.

Except for works of a minor nature and works which do not involve connection of copper pipes by soldering, licensed plumbers shall be employed for the construction, installation, maintenance, repair, etc. of the inside service system.

In response to the discovery of excessive lead levels in drinking water in some public rental housing (PRH) estates in July 2015, the WSD has taken a number of measures since July 13 to minimise the potential risk of contamination by heavy metals from the inside service system of new buildings:

- For all applications for new water supply, if soldering is used in connecting water pipes, a supporting document of lead-free soldering materials is required;
- Four additional test parameters (Lead, Cadmium, Chromium and Nickel) were added for testing of water samples during the final inspection of newly installed fresh water inside service systems in buildings.

International standards for drinking water supply

The WHO produces international norms on water quality and human health in the form of guidelines that are used as the basis for

regulation and standard setting in developing and developed countries worldwide. The WHO's guidelines are not the only international standard.

In Hong Kong, the WSD has pledged to supply fresh water of quality that totally complies with the WHO Guidelines.

According to the WHO, the guideline values represent the concentration of constituents in drinking water that will not result in any significant health risk to a person weighing 60kg over a lifetime consumption of 2 litres per day for 70 years. As a result, any short-term deviation of individual parameters is unlikely to impair health or cause an immediate health risk. The key point is to identify the causes of non-compliance and take appropriate remedial action to rectify the situation.

Many developed economies such as the European Union, the USA and New Zealand have set their own national water quality standards based on the WHO Guidelines.

Due to local variations, there are differences in the limiting values of some parameters (e.g. heavy metals) in different countries. The acceptable compliance rate, which is normally in the range from 90% to 99%, also varies from one country to another. In the USA, for example, if the lead concentration in more than 10% of tap water samples exceeds the action level of 15 µg/litre, the water authority/supplier is legally required to collect additional samples, enhance corrosion control measures and implement an extensive public education campaign.



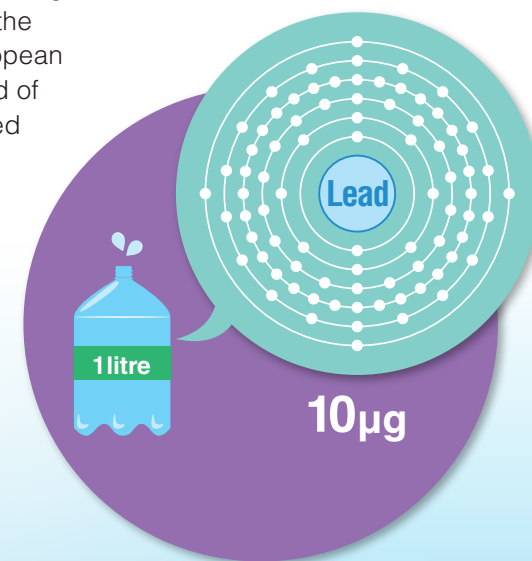
For heavy metals, the current international standards are:

Parametres (µg/l)	WHO	EU	USA	New Zealand	Hong Kong
Lead	10 [#]	10	15	10	10
Cadmium	3	5	5	4	3
Chromium	50	50	100	50	50
Nickel	70	20	-	80	70

10 µg/l is approximately equivalent to one drop of water in 40 standard-sized swimming pools.

Brief history of development of limiting value for lead

The current lead limiting value of 10 µg/litre has evolved by stages over a long period of time. Before 1984, the WHO, the UK and many European countries adopted a standard of 100 µg/litre. The WHO lowered the limit to 50 µg/litre and 10 µg/litre in 1984 and 1993 respectively whilst the UK and European countries also tightened the limit to 50 µg/litre and 25 µg/litre in 1988 and 2003 respectively. Since the end of 2013, the EU has formally adopted the WHO standard of 10 µg/litre.



Precautionary measures

In early July 2015, the lead content of some water samples from PRH estates were found to exceed the guideline value set by the WHO. Subsequently, lead was found in the solder used on the water pipe joints of these estates. The Government has attached great importance to this matter. An inter-departmental meeting chaired by the Chief Secretary for Administration was held on July 11 during which decisions were made on crucial follow-up work and measures. The Development Bureau has established a Task Force to determine the cause of the incidents whilst the Hong Kong Housing Authority (HA) has formed a Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates. The Review Committee is tasked to comprehensively review the present arrangements for quality control and monitoring in relation to the fresh water supply systems in PRH estates. The Chief Executive in Council has approved the setting up of a Commission of Inquiry under the Commissions of Inquiry Ordinance to inquire into the incidents of excess lead found in drinking water.

Before the excess lead content issue can be fully resolved, residents of affected estates can take the following precautionary measures:



Use of drinking water

1. If water has not been used overnight, run water taps for one to two minutes each morning before taking any water for drinking or cooking. To avoid wastage, you may use a container to collect the water for non-drinking purposes.
2. As it is easier for lead in pipes and fittings to leach into hot water, only consume water from cold water taps.
3. Lead in water cannot be removed by boiling.

More easily affected groups

4. Alternative source of drinking water such as distilled water should be used for drinking by and cooking for infants, children under six, pregnant women and lactating women.⁴

Water filtration devices

5. Not all water filters can remove lead in water. Water filters certified by the U.S. National Sanitation Foundation (NSF) 53 standard are among those recognised to be capable of reducing lead content in water. Most water filters do not have this function.
6. Strictly follow the manufacturer's instructions on the use and maintenance of water filters to achieve the performance claimed by the manufacturer, including the frequency of replacement of major parts. Without proper maintenance, water filters may become an ideal breeding ground for bacterial growth.

Note 4: The Government immediately provided bottled water and deployed water wagons for tenants of affected housing estates. Tenants can also collect water from temporary water tanks on the ground floors of the estates and temporary water supply systems on respective floors. The Government has also arranged briefings and provided health information for the tenants and requested the contractors to conduct investigation and take follow-up action.

In addition, the Government has arranged whole blood lead level tests for more easily affected people and followed up as appropriate.

7. As the activated carbon in water filters may reduce the level of residual chlorine in water, filtered water should be boiled to kill the germs before consumption.

Inspection of water supply system

8. You may engage an accredited laboratory to take water samples for testing. The list of accredited laboratories is available at the website of the Innovation and Technology Commission:
www.itc.gov.hk/en/quality/hkas/doc/Testing_of_lead_and_other_heavy_metals_in_water.pdf
9. If the test results show that the level of lead in drinking water does not comply with the WHO standard, you should act immediately according to the health advice given by the Centre for Health Protection. For details, please refer to the website:
www.chp.gov.hk/en/view_content/40398.html
10. You should discuss with your estate/building management office, flat owner or the owners' committee to engage relevant professionals, including licensed plumbers, building services engineers or building surveyors, etc., to inspect the inside service system to identify the source of excessive lead content and take appropriate remedial measures. For the inspection, you can also check the completion year of the building and the materials of the water pipes and fittings. If you suspect that soldering materials with excessive lead content were used to connect pipes, you can arrange testing of the lead level of the joint to confirm whether this is the source.
11. When planning renovation or replacement of pipes and fittings, except for works of a minor nature and works which do not

involve the connection of copper pipes by soldering, employ a licensed plumber to carry out the work and make sure all materials that come into contact with drinking water (including all pipes, joints, soldering materials, valves, taps and other fittings) comply with the relevant British Standards for potable water use.

For information on licensed plumbers and the approved water supply pipes and fittings, water heaters and materials, please visit the WSD's website:

Licensed Plumber Directory
www.wsd.gov.hk/en/plumbing_and_engineering/licensed_plumber/index.html

Water Supply Pipes and Fittings, Water Heaters and Materials Directory
www.wsd.gov.hk/en/plumbing_and_engineering/fittings_to_be_installed_or_use/pipes_and_fittings_water_heaters_and_materials/index.html



Government action to deal with the lead-in-water issue

- Testing water samples at public housing estates

Given public concern over the incident, the Chairman of the HA announced on July 24, 2015 that the scope of water sampling for PRH estates would be extended. The Housing Department and the WSD are now systematically taking water samples from over 100 blocks from PRH estates completed between 2005 and 2010 by batches for testing. The testing work is expected to be completed in September 2015. The next step forward will be planned taking into consideration the experience gained and the data collected.

- Alternative water supply

As it will take a comparatively longer period of time to draw up a plan to resolve the incident completely, during the transition period, the HA has asked the main contractors concerned to take actions to remedy the situation, including extending connection pipes from the roof-top water tanks to each floor of the building, and installing lead-reducing water filters with U.S. NSF 53 certification for affected tenants. The HA will consider adjusting the arrangements depending on the circumstances.

- Providing water filters for affected PRH tenants

Not all water filters can remove lead from water. Those with U.S. NSF 53 certification is one type of filters verified to be lead-reducing. Most water filters do not perform this task.



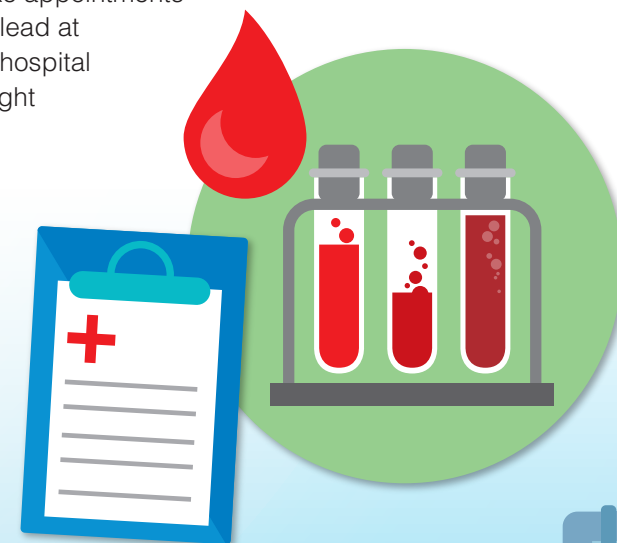
The contractors concerned will provide these water filters with NSF 53 certification to households affected by the lead-in-water issue.

- Blood tests

Whole blood lead level is recognised internationally as the most accurate and reliable method for screening and diagnosis when assessing the risk of lead on health. Using hair and urine samples for screening and diagnosis for lead exposure is not reliable. Such tests are therefore not advisable.

Infants and young children aged under six, pregnant women and lactating women are more easily affected by lead. When the same amount of lead in drinking water is consumed, young children absorb 4-5 times as much ingested lead when compared with an adult. Children are at a rapid stage of growth, and their developing organs and tissues are more susceptible to the toxic effects of lead. Moreover, lead absorbed by pregnant women and lactating women indirectly reaches the fetus and young children.

As a precautionary measure, these individuals may make appointments for blood testing for lead at a Hospital Authority hospital through the DH. In light of public concern, the scope of blood testing has been expanded at discretion to cover children under eight living in affected estates.



- What the blood tests mean

In everyday life, lead is found everywhere and some kind of exposure is inevitable. Lead can enter the human body through inhalation and ingestion. Notwithstanding this, it is always good for health to achieve the lowest possible lead level in the body. Taking reference from medical literature as well as local and overseas experience, the Hospital Authority and the DH have derived the reference values of blood lead level and corresponding actions to be taken in various health care settings.

For children, pregnant women and lactating women, a blood lead level less than 5 microgram/decilitre is considered normal with no significant risk to health. A blood lead level of equal to or more than 5 microgram/decilitre means there is potential risk to health which requires further health evaluation and follow-up. For adults, a blood lead level of equal to or more than 10 microgram/decilitre requires health evaluation and follow-up.

- Counselling, treatment and advice

The most important and effective management is to identify and stop the source of exposure so that lead will gradually be cleared from the body. The key feature of the health care plan is to conduct a health risk assessment according to different blood lead levels and then take suitable actions accordingly.



Whole blood lead level (microgram/decilitre)	Health risks	Actions in different health care setting
Normal (Persons below 18-year-old, pregnant women and lactating women: < 5 Adults: < 10)	No significant health risk No follow-up required	<ul style="list-style-type: none"> • DH will inform individuals about the results
Borderline raised to raised (Persons below 18-year-old, pregnant women and lactating women: 5-44 Adults: 10-50)	Potential health risk Health evaluation and follow-up required	<ul style="list-style-type: none"> • DH will perform lead exposure assessment and arrange preliminary developmental assessment • HA will arrange health education, evaluation and monitor blood lead level
Significantly raised to toxic level (Persons below 18-year-old, pregnant women and lactating women: > 44 Adults: > 50)	Risk of lead poisoning Need clinical assessment and follow-up	<ul style="list-style-type: none"> • DH will perform lead exposure assessment and arrange preliminary developmental assessment • HA will arrange medical assessment, follow-up and monitor blood lead level

- Investigation and Review

Task Force headed by WSD

The Government established a Task Force headed by the WSD on July 15, 2015 to investigate the causes of excessive lead content found in drinking water at public housing estates. Members include independent experts outside the Government. The task force will inspect the water pipes, soldered pipe joints and fittings of the estates concerned. It will recommend measures to prevent recurrence of similar incidents in future.



Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates

On July 24, 2015, the HA set up the Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates to comprehensively review the present arrangements for quality control and monitoring in relation to the installation of fresh water supply systems in public housing estates.

Independent Commission of Inquiry

At a special Executive Council meeting on August 13, 2015, the Chief Executive in Council approved the setting up of a Commission of Inquiry under the Commissions of Inquiry Ordinance (Cap. 86) to inquire into the incidents of excess lead found in drinking water. Its terms of reference are to: (a) ascertain the causes of excess lead found in drinking water in public rental housing developments; (b) review and evaluate the adequacy of the present regulatory and monitoring system in respect of drinking water in Hong Kong; and (c) make recommendations with regard to the safety of drinking water in Hong Kong.

Expert quotes

“There are many possible causes of ‘excessive’ lead in drinking water and blood. Scientific investigation suggests that apart from the pollution of construction materials and pipes, environmental pollution (e.g. emissions from vehicles using leaded petrol and lead in contaminated soil), food (e.g. preservatives and seasonings in preserved eggs), cosmetic products (e.g. ingredients of nail polishes) and fishing nets commonly used by fishermen for carrying heavy loads are also possible contributing factors... According to the WHO Guidelines, the concentration of constituents in drinking water, if complying with the WHO standard, will not result in any risk of lead-related diseases to an adult of normal weight over a lifetime’s consumption for 70 years. As to how many years a person will catch diseases by drinking water containing excessive lead, it varies among individuals and places. The medical sector should give careful diagnoses and conduct detailed studies in respect of individual cases, so as to provide targeted precautions and treatment. Even if the lead content in drinking water exceeds the Guideline’s limit in the short term or intermittently, we can still minimise the risk of diseases by timely detection and taking early control of the problem.”

Professor Ho Kin Chung,
Dean of the School of Science and Technology at
the Open University of Hong Kong and
former Chairman of the Advisory Committee on the Quality of Water Supplies

“Although lead is toxic, most minor exposures will not result in clinical poisoning. For those residents with a mildly elevated blood lead level, if further exposure is avoided, their health should not be much affected.”

Hong Kong Society of Clinical Toxicology

“Children who have already been exposed to environmental lead with elevated blood lead levels most often do not show any clear physical signs or specific symptoms. Symptoms that do arise include tiredness, muscle ache, headaches, gastrointestinal issues, irritability and difficulty in concentration. Other developmental deficits in cognitive function, attention and academic achievement may occur. These symptoms and developmental problems can also be associated with many other common illnesses and factors. It must be emphasised that developmental or behavioural problems usually have multifactorial aetiologies. Ensuring a currently safe lead-free environment is essential. For children with a history of lead exposure, besides monitoring their developmental progress, provision of a nurturing and stimulating family environment should contribute to amelioration of any potential developmental effects, and promote optimal and healthy development for these children.”

Developmental-Behavioural Paediatrics Subspecialty Board
Hong Kong College of Paediatricians

Telephone hotlines

Department of Health

2125 1122

Water Supplies Department

2824 5000

Housing Authority

2712 2712



Useful information and websites

Lead in Drinking Water Incidents

www.isd.gov.hk/drinkingwater/eng/

Commission of Inquiry into Excess Lead Found in Drinking Water

www.coi-drinkingwater.gov.hk/eng/index.html

Transport and Housing Bureau

www.thb.gov.hk/en/index.htm

Development Bureau

www.devb.gov.hk/en/home/index.html

Food and Health Bureau

www.fhb.gov.hk/en/index.html

Housing Department

www.housingauthority.gov.hk/en/index.html

Water Supplies Department

www.wsd.gov.hk/en/home/index.html

Department of Health

www.dh.gov.hk/eindex.html

Centre for Health Protection

www.chp.gov.hk/en/index.html

Hospital Authority

www.ha.org.hk/visitor/ha_index.asp

Water Safety Plan

www.wsd.gov.hk/en/water_resources/water_safety_plan/index.html

Guidelines for Drinking-water Quality, fourth edition

whqlibdoc.who.int/publications/2011/9789241548151_eng.pdf

